The Latest in Oncology Management: Diagnostic Nuclear Medicine and Molecular Imaging

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Speaker Introductions

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Overview

- Cancer statistics in the United States
- Overview of nuclear medicine and molecular imaging
- Nuclear medicine vs. traditional anatomic imaging
- Terminology for nuclear medicine and molecular imaging techniques
- The role of nuclear medicine and molecular imaging in cancer management
- Sources for practice guidelines
- The role of external independent medical review for diagnostic nuclear medicine and molecular imaging in oncology

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Cancer in the United States

- American Cancer Society (ACS) estimates for 2011
  - About 1.6 million new cancer cases will be diagnosed
  - Almost 600,000 Americans expected to die of cancer
- Cancer is the second most common cause of death, exceeded only by heart disease

ACS. *Cancer Facts & Figures 2011*. Available at: http://www.cancer.org/acs/groups/content/@epidemiologysurveilance/documents/document/acspc-029771.pdf.

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The Good News…

- The death rate for cancer has generally been declining steadily since 1991
- 5-year survival rates have been increasing since 1991
- Reflects improvement in early detection and treatment
  - Nuclear medicine and molecular imaging have become part of the standard of care for many types of cancer

ACS. *Cancer Facts & Figures 2011*. Available at: http://www.cancer.org/acs/groups/content/@epidemiologysurveilance/documents/document/acspc-029771.pdf.

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What Are Nuclear Medicine and Molecular Imaging?

- Functional imaging technologies involving the use of radioactive isotopes in the diagnosis and treatment of disease
  - Allow functional visualization of virtually any area of the body
- Constantly evolving technologies that provide greater insight into the functioning of the body in various disease states
  - Provide important clues regarding treatment

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Nuclear Medicine vs. Traditional Anatomic Imaging

- Traditional anatomic imaging (e.g., CT, MRI)
  - Provides images of structures of the body
  - Allows physicians to gather information regarding the anatomy
  - Determines the presence of disease on the basis of changes in organ structure
- Nuclear medicine
  - Allows physicians to gather information predominantly about function
  - Determines the presence of disease on the basis of metabolic changes, thus revealing abnormalities that static forms of anatomic imaging cannot detect

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How Does Diagnostic Nuclear Medicine Work?

- Uses small amounts of radioactive materials (radiopharmaceuticals or tracers specifically targeted to a certain organ function)
  - Given by injection, swallowing, or inhalation
  - Radiopharmaceuticals emit small amounts of radiation as they move through the body, making it possible to visualize specific disease and treatment processes
- Specialized cameras (e.g., PET or SPECT/gamma camera) detect the emitted radiation
  - Resulting images reflect the function of the organ system or metabolic process being evaluated

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Molecular Imaging: A Highly Targeted Version of Nuclear Medicine

- Illustrates function on a deeper and even more specific molecular level
- Allows physicians to see how the body is functioning and to measure its chemical and biological processes
- Provides information that other imaging technologies cannot provide or that would otherwise require more invasive procedures such as biopsy or surgery
- Identifies disease in its earliest stages and determines exact location of a tumor before symptoms occur or abnormalities can be detected with other diagnostic tests
- Shifts paradigm from treating late disease to pinpointing and diagnosing disease sooner

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Nuclear Medicine and Anatomic Imaging: Complementary Roles in Oncology

- Nuclear medicine images can be superimposed on CT or MRI images
  - Nuclear medicine provides functional images
  - Anatomic imaging provides higher resolution structural images
  - Information from the two different modalities are correlated together to produce hybrid studies
  - Allows precise anatomic localization of functional abnormalities

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Nuclear Medicine and Molecular Imaging Techniques: Clarifying Terminology

- Scintigraphy is a 2D “standard” nuclear medicine procedure
  - Example: Bone scintigraphy (“bone scan”) that is routinely done in prostate cancer patients to look for bone metastases
- Single-photon emission computed tomography (SPECT) is a 3D technique applicable to many standard scintigraphic studies (increases resolution of the exam)
  - Analogy in anatomic imaging: Standard chest x-ray (2D) vs. chest CT scan (3D)
  - Although many tests can be done in 2D (scintigraphy) or in 3D (SPECT), SPECT yields a much superior result and is the typical default
- Positron emission tomography (PET) is a specific type of molecular imaging
  - The most common active molecule used for imaging is FDG (an analog of glucose)
  - Several other active molecules are available or in development

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Hybrid Techniques

- Correlative imaging has been used in clinical practice for many years, particularly for nuclear medicine studies
  - Technical limitations include those relating to the different geometries of the imaging equipment, different patient positioning, and displacement of the mobile structures between studies
- Limitations of correlative imaging led to the development of hybrid devices, such as PET/CT, SPECT/CT, and PET/MRI units
  - Enable precise correlation of functional/metabolic abnormalities with anatomic structure

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Cancer Management: The Role of Nuclear Medicine and Molecular Imaging

- Diagnosis and staging
- Treatment planning
- Monitoring response to therapy
- Monitoring for recurrent/residual disease

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Nuclear Medicine and Molecular Imaging in Cancer: Diagnosing and Staging

- Detects disease that would go undetected by other imaging modalities
- Staging is necessary once cancer is detected in order to determine extent or severity of disease, including degree of spread throughout the body
- Studies often result in changed staging
  - Upgrading or downgrading the initial staging done by routine methods (i.e., clinically and with anatomic imaging such as CT and MRI)
  - Altered staging is critical in that it typically results in altered management

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Nuclear Medicine and Molecular Imaging in Cancer: Treatment Planning

- Most effective therapy is selected based on the:
  - Unique biologic characteristics of the patient
  - Molecular properties of the tumor or other disease that the studies reveal

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Nuclear Medicine and Molecular Imaging in Cancer: Monitoring Response to Therapy

- Best done with functional imaging rather than anatomic imaging
  - Typically anatomic changes will lag behind functional changes
  - Anatomic changes can be misleading
- Time is critical
  - Functional imaging allows treatment to be altered midcourse, if necessary, as opposed to waiting for structural changes revealed by anatomic imaging much further down the line, while completing a course of therapy that may not be particularly effective

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Nuclear Medicine and Molecular Imaging in Cancer: Monitoring for Recurrent/Residual Disease

- Nuclear imaging is quite useful for detection of residual disease or surveillance for recurrence
- A classic use for nuclear imaging: To evaluate focal soft tissue in a tumor bed after treatment as demonstrated by CT or MRI, which are unable to differentiate scar tissue from residual tumor, unlike PET imaging

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Nuclear Medicine and Molecular Imaging in Cancer: Sources for Practice Guidelines

- Centers for Medicare & Medicaid Services National Coverage Determinations (CMS NCD) Manual
  - Particularly useful for PET imaging standards
- National Comprehensive Cancer Network (NCCN)
  - Details the workup and surveillance for all of the most common cancers
- Society for Nuclear Medicine
  - Provides useful guidelines for oncology
  - Recently announced a collaboration with the NCCN to advance research for cancer imaging and therapy

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The Role of External Independent Review in Oncology

- An independent medical review:
  - Looks at whether or not a specific procedure was medically necessary
  - Avoids issues such as conflicts of interest, not having the appropriate specialists to review cases, or having the same physician who initially denied a claim also review an appeal
- Independent review organizations (IROs) provide specialty match
  - Especially important since nuclear medicine and molecular imaging require a high degree of specialized training
  - Board-certified physician specialists who work with IROs keep up-to-date with the latest medical literature, the latest standard of care, and continually evolving technology and treatments

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Conclusions

- Diagnostic imaging technologies have become increasingly sophisticated in recent years
- Nuclear medicine and molecular imaging:
  - Allow physicians to assess function (i.e., what is happening in the body at cellular and molecular levels)
  - Provide precise localization of functional abnormalities when combined with traditional anatomic imaging (CT and MRI)
- Advances in diagnostic imaging help optimize the disease management process and can increase the chance and length of survival

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Conclusions (cont'd)

- Independent review organizations (IROs) provide ready access to specialists, which healthcare plans may lack internally, allowing for timely determination of whether the requested treatment falls under medical necessity guidelines
- Independent medical reviews provide unbiased evaluation of medical need for nuclear medicine and molecular imaging in cancer diagnosis and management

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